8.4 GEOLOGICAL HAZARDS AND RESOURCES

This section presents an evaluation of potential impacts to geological resources and the potential geological hazards that might result from construction and operation of the Pico Power Project (PPP). Section 8.4.1 describes the existing environment that the project may affect. Section 8.4.2 identifies potential impacts on the environment associated with development of the PPP. Section 8.4.3 discusses potential cumulative impacts, and Section 8.4.4 addresses proposed mitigation measures. Section 8.4.5 presents the laws, ordinances, regulations, and standards applicable to geological resources and hazards. Section 8.4.6 describes the agencies involved and provides agency contacts, and Section 8.4.7 describes permits required. Section 8.4.8 provides the references used to develop this section.

8.4.1 Affected Environment

8.4.1.1 Physiographic Setting

The project area is located within the northern end of the Santa Clara Valley, just south of San Francisco Bay, and lies centrally within the Coast Ranges geologic/geomorphic province of central and northern California. The Coast Ranges extend from the Transverse Ranges province approximately 300 miles south of the project site to about 275 miles north where the province meets the Klamath Mountains. The Coast Ranges province is bordered on the west by the Pacific Ocean and to the east by the Great Valley province which includes the Sacramento and the San Joaquin valleys. The Coast Ranges have a general northwest-southeast orientation and are characterized by northwest-southeast trending folds and faults.

The Santa Clara Valley fills a northwest-trending structural depression bound on the east by the Hayward and Calaveras Fault zones and further east by the Diablo Mountain Range and to the west by the Coast Ranges, specifically the Santa Cruz Mountains, and the San Andreas Fault zone. The project area is located approximately 12 miles east of the San Andreas Fault and 5 miles west of the Hayward Fault.

The Santa Clara Valley consists chiefly of a number of confluent alluvial fans and flood plains formed by deposits from the numerous streams that enter the valley from both mountain systems. The comparatively smooth floor of the valley ranges in elevation from 100 to 400 feet above mean sea level. An imperceptible alluvial divide at Morgan Hill, located approximately 25 miles south of the project site, separates the drainage of the valley into a north-flowing system and a south-flowing system (California Division of Mines and Geology [CDMG] 1978). The former drains into the San Francisco Bay to the north and the latter leads to the Pajaro River and eventually flows into Monterey Bay to the south.

The Diablo Mountains, located approximately 10 miles east of the project site, separates the Santa Clara Valley from the San Joaquin Valley. This range of rolling hills and mountainous uplands consists of small intervening valleys and several parallel ridges having slopes of 20 to 60 percent.

The Santa Cruz Mountains, located approximately 10 miles west of the project site, consists of a number of complex ridges or small ranges with rugged slopes that range in gradient from 40 to 60 percent or more. The foothills of the Santa Cruz Mountains, which range in elevation from 250 to 1,000 feet, display an undulating to rolling relief with slopes grading from 5 to 35 percent.

The project area is located in the Milpitas 7.5-Minute Quadrangle and is approximately 2.86 acres in size. The topography of the site is relatively flat with an approximate elevation of 32 feet above mean sea level.

8.4.1.2 Regional Geology

The regional geology surrounding the project site is structurally complex, largely as a result of the interaction of the strike-slip tectonics of the San Andreas Fault system and the compressional tectonics of the Coast Ranges. Most of the rocks in the Santa Clara Valley and San Francisco Bay (Bay) area were folded and faulted as a result of early convergence of the North American and Pacific plates. About 10 million years ago, the tectonic regime in the Bay area changed from convergent to a transform boundary between the North American and the Pacific plates. In the Bay area, the relative horizontal (strike-slip) movement along this boundary is about 47 millimeters per year (mm/yr), and is being distributed among the various faults of the San Andreas system (Petersen et al. 1996). Over geologic time, the San Andreas Fault accommodates about 24 mm/yr of this movement, while the Hayward Fault accommodates about 9 mm/yr at Fremont (Petersen et al. 1996).

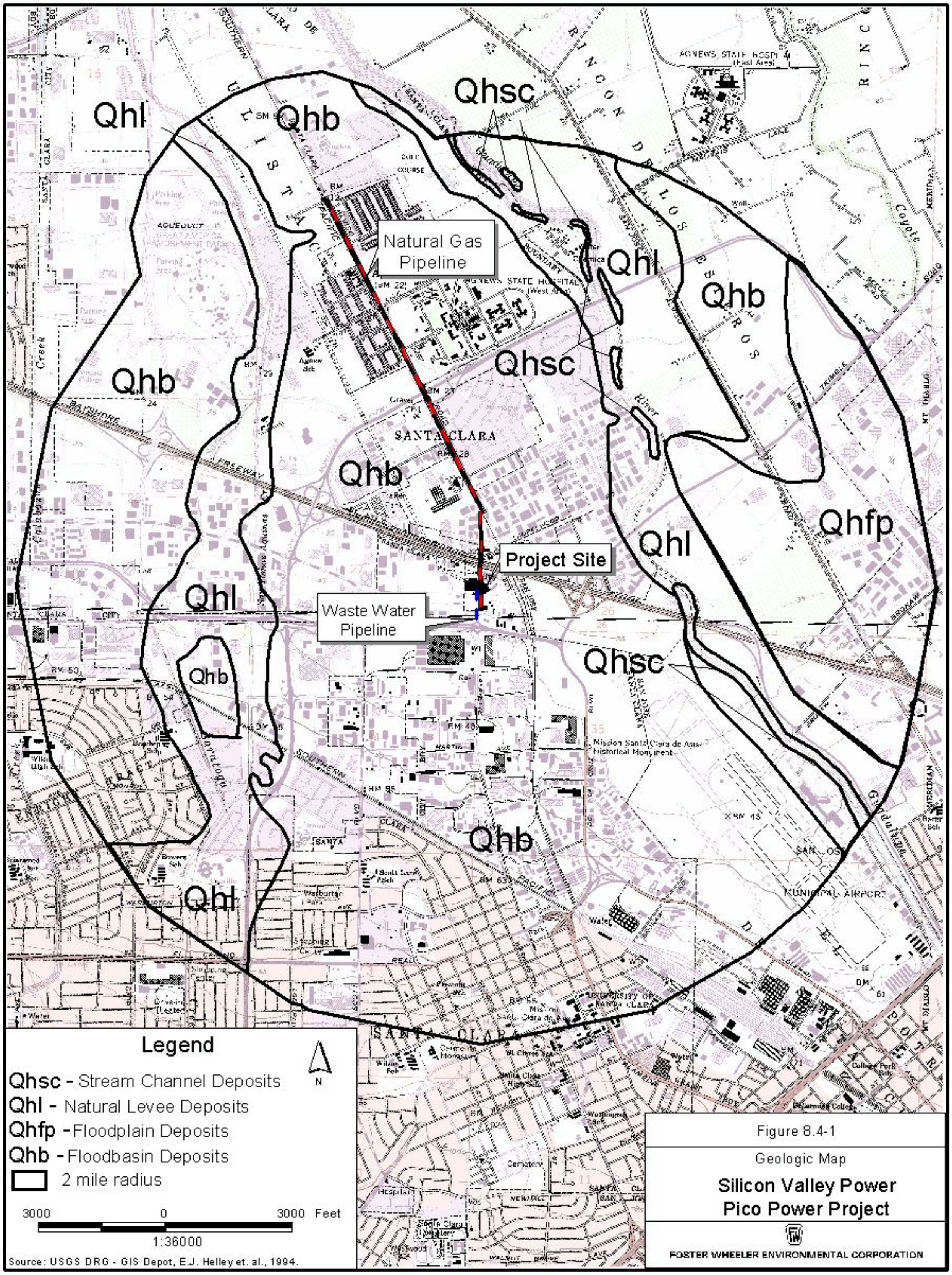
The oldest rocks known to underlie the project area and exposed in part in the Santa Cruz Mountains and Diablo Ranges are those of the Franciscan Assemblage, which are Jurassic to Cretaceous in age (50 to 200 million years old). These rocks are believed to have accreted onto the North American plate during subduction events that ended in the Miocene time (Page 1992). Parts of the accreted assemblage form coherent, solid rock, whereas other parts of the complex have been sheared and disrupted, and consist of a melange of exotic blocks of basalt, chert, limestone, gabbro, blueschist, eclogite, and amphibolite that are embedded in a tectonic paste of sheared shale, graywacke sandstone, or serpentinite (Wahrhaftig 1989; Page 1992). This basement rock is at a depth of about 900 to 4,265 feet below the project site (Robbins 1971).

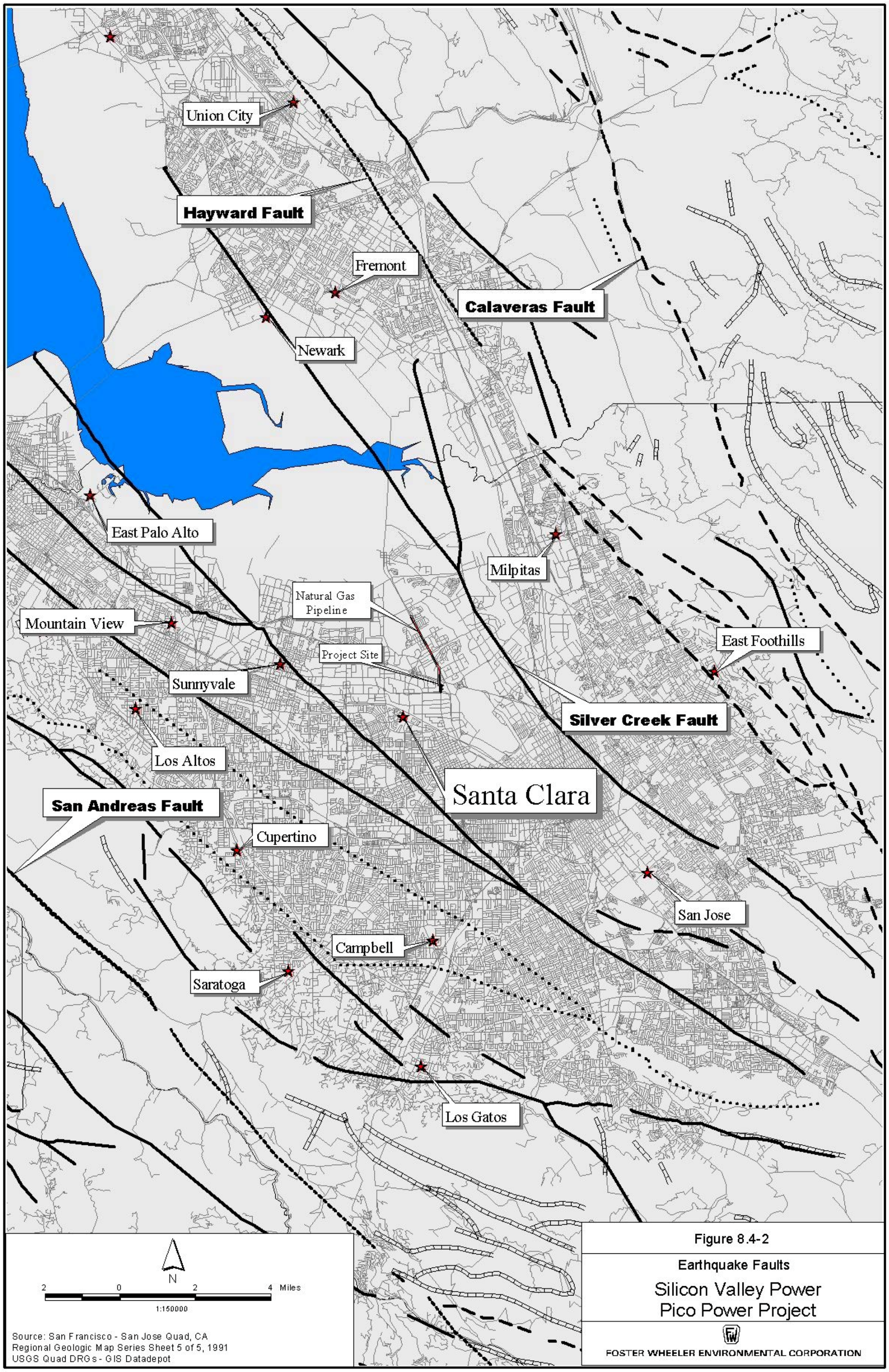
Overlying the Franciscan Assemblage are undivided Tertiary marine strata and Cretaceous marine sedimentary rocks consisting of sandstone, mudstones, conglomerates, and minor limestone. The Cretaceous and Tertiary strata were separated on the basis of fossil data and minor compositional differences (CDMG 1978). The surficial rocks in the Santa Clara Valley and on the slopes and valleys of the adjacent mountain ranges consists of Quaternary alluvial and colluvial deposits. The thickness of the alluvial deposits beneath the valley floor is approximately 225 feet (CDMG 1978).

8.4.1.3 Local Geology

Figure 8.4-1 is a geologic map (1:36,000 scale) of the project area including the natural gas supply line and waste water discharge pipeline. As shown on Figure 8.4-1, the project site is underlain by Holocene age (11,000 years ago to present) floodbasin deposits (Qhb) (Helley et al. 1994). These sediments consist predominately of unconsolidated, plastic, moderately to poorly sorted silt and clay rich organic material, and were likely deposited as a result of periodic flooding by the Guadalupe River and San Tomas Aquinas Creek, located approximately one-half mile east and approximately one mile west of the project area, respectively. The floodplain and levee deposits are estimated to be 10 feet thick (Helley et al. 1979).

A geotechnical report prepared for the site by Terratech (1986) indicates that the surface of the site is predominately covered by imported sandy gravel up to a depth of two feet, which was placed to minimize ponding of water. Below the imported gravel are native soils that consist of a dark gray to black, stiff to very stiff clay that exhibits a high plasticity and high expansion potential to a depth of 4.5 feet. Below this expansive near-surface zone, the native clay soils generally contain an increasing amount of caliche with depth, which decrease their plasticity and expansion potential. At an approximate depth of 12.5 feet, a dense clayey gravelly sand was encountered beneath the site. The depth to groundwater is approximately 12 feet below ground surface (bgs) (Terratech 1986). This information was corroborated by a geotechnical report done for the Pico Project by Kleinfelder (see Appendix 10-G).


Qhsc
Qhl
Qhb
Natural Gas Pipeline
Qhfp
Project Site
Waste Water Pipeline
SANTA CLARA
Legend
Qhsc - Stream Channel Deposits
Qhl - Natural Levee Deposits
Qhfp - Floodplain Deposits
Qhb - Floodbasin Deposits
2 mile radius
3000 0 3000 Feet
1:36000
Source: USGS DRG - GIS Depot, E.J. Helley et. al., 1994.
Figure 8.4-1
Geologic Map
Silicon Valley Power
Pico Power Project
FOSTER WHEELER ENVIRONMENTAL CORPORATION


Union City
Hayward Fault
Fremont
Calaveras Fault
Newark
East Palo Alto
Milpitas
Natural Gas Pipeline
Mountain View
Project Site
East Foothills
Sunnyvale
Silver Creek Fault
Los Altos
Santa Clara
San Andreas Fault
Cupertino
San Jose
Campbell
Saratoga
Los Gatos
N
2 0 2 4 Miles
1:150000
Source: San Francisco - San Jose Quad, CA
Regional Geologic Map Series Sheet 5 of 5, 1991
USGS Quad DRGs - GIS Datadepot
Figure 8.4-2
Earthquake Faults
Silicon Valley Power
Pico Power Project
FOSTER WHEELER ENVIRONMENTAL CORPORATION

The most notable faults in the project area are the San Andreas, Hayward, Sargent, and Calaveras faults. Another prominent related fault of lesser extent is the Silver Creek Fault, which branches off the southern portion of the Calaveras Fault. The San Andreas and the Sargent faults subparallel the western boundary of Santa Clara Valley and separate Tertiary strata from Jurassic rocks. The Hayward and Calaveras faults are nearly parallel to each other on the western side of the Diablo Range. The four major fault systems are predominately strike-slip type, with probable large right lateral displacements. The location of these faults with respect to the project area is shown on Figure 8.4-2.

8.4.1.4 Seismic Setting

The project area is located near four active fault zones: the San Andreas fault zone 12 miles to the west; the Sargent fault zone 17 miles to the southwest, the Hayward Fault Zone (southern extension) 5 miles to the east, and the Calaveras Fault Zone passing 9 miles to the east. A fault zone, such as the San Andreas, is a group of tectonically related fault traces (or strands) which lie in a parallel or near-parallel configuration. The Sargent, Hayward, and Calaveras fault zones are fracture zones that are part of the larger San Andreas Fault system.

Table 8.4-1 identifies all active faults that may pose a potential geologic hazard to the project area (Petersen et al. 1996). Active faults are those that show evidence of displacement during Holocene time (11,000 years ago to present). In addition, Table 8.4-1 identifies the approximate distance from the project site, nature of displacement, slip rate, maximum moment magnitude (M), recurrence interval, location, and various other characteristics unique to each fault.

As shown in Table 8.4-1, the San Andreas Fault and Hayward Fault are close to the site and are classified as “A” type faults. Faults with an “A” classification are capable of producing large magnitude events (M $\geq$ 7.0), have a high rate of seismic activity (i.e., having slip rates greater than 5 mm/yr), and have well constrained paleoseismic data (i.e., evidence of displacement within the last 700,000 years). The San Andreas Fault and Hayward Fault systems are historically the most active of those listed in Table 8.4-1 and, because of their proximity to the site, present the greatest seismic hazard. Table 8.4-1 also lists “B” class faults, which lack paleoseismic data necessary to constrain the recurrence intervals of large-scale events. Faults with a “B” classification are capable of producing an event of magnitude 6.5 or greater.

The Silver Creek Fault is located approximately 2 miles east of the project area. Although there is evidence to suggest the Silver Creek Fault could be active, considerable disagreement still remains about the history of recent movement along this fault (CDMG 1978). The fault does not display either geomorphic or paleoseismic evidence of activity (CDMG 1991), i.e., there is no evidence of seismic activity within the Holocene.

Hayward Fault Zone

The project site is located approximately 5 miles (8 km) west of the Hayward Fault Zone. The Hayward Fault Zone consists of one known active strand and as many as three sub-parallel strands that generally lie east of the active strand. The active strand is marked by shutter ridges; offset streams; cultural features such as offset railroad tracks, roads, sidewalks, and building foundations; and active creep. Evidence for parallel fault strands in the eastern part of the fault zone is less abundant. For the most part, the fault traces are defined by linear features such as topographic benches and narrow ridges (USGS 1970).

The Hayward Fault Zone is the southern segment of an extensive fracture zone consisting of the Hayward Fault and the Rodgers Creek, Healdsburg, and Macama fault segments. The zone extends northwest to

Table 8.4-1. Active faults in the project area.

FAULT NAME AND GEOMETRY (ss) strike slip, (r)reverse, (n) normal (rl) rt. lateral, (ll) left lateral, (o) oblique	Distance from PPP (km)**	Length (km)	Slip Rate (mm/yr)	Rank (1)	Mmax (2)	R.I. (3)	Rake	Dip	Endpt. N	Endpt. S	Comment
A FAULTS											
SAN ANDREAS FAULT ZONE											
San Andreas (Peninsula) (rl-ss)	20	88	17.00	M	7.1	400	180	90	-122.60;37.81	-122.00:37.18	Slip rate is based on Clahan et al. (1995) and assumptions by WGNCEP (1996). Max. magnitude based on 1.6 m displacement.
San Andreas (1906) (rl-ss)	20	470	24.00	M	7.9	210	180	90	-124.41;40.25	-121.51;36.82	Slip rate based on Neimi and Hall (1992) and Prentice, et al (1991). Assumption that 1906 events rupture North Cost, Pennisula, and Santa Cruz Mtns. Segments to San Juan Bautista. Max magnitude based on 1906 average 5 m displacement (WGCEP 1990; Liekaemper 1996)
HAYWARD FAULT ZONE											
Hayward (total length) (rl-ss)	8	86	9.00	M-W	7.1	167	180	90	-122.41; 38.05	-121.81; 37.45	Well-constrained slip rate for southern segment reported by Lienkaemper et al. (1995) and Lienkaemper and Borchardt (1995). Recurrence (167 yrs) and slip per event (1.5 m) are based on WGCEP (1990). Model weighted 50%.
Hayward (south) (rl-ss)	8	43	9.00	W	6.9	167	180	90	-121.13; 37.73	-121.81; 37.45	Well-constrained slip rate reported by Lienkaemper et al. (1995) and Lienkaemper and Borchardt (1996). Recurrence (167 yrs) and slip per event (1.5 m) are based on WBCEP (1990). The southern segment can be projected to Calaveras fault along prominent zone of seismicity. Net slip rate of 9 mm/yr can be resolved into 3 mm/yr vertical and 7.6 mm/yr r.l. along postulated Mission Link blind thrust of Andrews, et al (1992) along with southern connection. Model weighted 50%.
Hayward (north) (rl-ss)	40	43	9.00	M	6.9	167	180	90	-122.41; 38.05	-122.13; 37.73	Well-constrained slip rate for southern segment reported in Lienkaemper et al. (1995) and Lienkaemper and Borchardt (1996). Recurrence (167 yrs) and slip per event (1.5 m) are based on WGCEP (1990). Model weighted 50%.

Table 8.4-1. (continued).

FAULT NAME AND GEOMETRY (ss) strike slip, (r)reverse, (n) normal (rl) rt. lateral, (ll) left lateral, (o) oblique	Distance from PPP (km)**	Length (km)	Slip Rate (mm/yr)	Rank (1)	Mmax (2)	R.I. (3)	Rake	Dip	Endpt. N	Endpt. S	Comment
B FAULTS											
SAN GREGORIO-HOSGRI FAULT ZONE											
Hosgri (rl-ss)	45	172	2.50	M-P	7.3	646	180	90	-121.73; 36.15	-120.69; 34.86	Slip rate based on San Simeon fault slip rate reported in Hanson and Lettis (1994).
San Gregorio (Sur region) (rl-ss)	45	80	3.00	P	7.0	411	180	90	-122.16; 36.81	-121.74; 36.18	Late Qt. Slip rate of 1-3 mm/yr based on assumed transfer of slip from Hosgri flt. Slip rate from San Simeon flt. (Hanson and Lettis (1994) and Hall et al (1994).)
San Gregorio (rl-ss)	40	129	5.00	P	7.3	400	180	90	-122.67; 37.89	-122.13; 36.81	Weber and Nolan (1995) reported Holocene slip rate of 3-9 mm/yr; latest Pleistocene slip rate of 5 mm/yr (min) and lt. Qt. Slip rate of about 4.5 mm/yr reported by Simpson et al. (written communication to J. Lienkaemper 1995).
CALAVERAS FAULT ZONE											
Calaveras (s. of Calaveras Reservoir) (rl-ss)	15	106	11	P-M	6.2	33	180	900	-121.79; 37.43	-121.18; 36.62	Includes Paicines fault south of Hollister. Slip rate is composite based on slip rate for a branch of Calaveras fault reported by Perkins & Sims (1988) and slip rate of Paicines fault reported by Harms et al. (1987). Creep rate for fault zone approximately 15 mm/yr. Maximum earthquake assumed to about 5.2 (Oppenheimer et al. 1990).
Calaveras (north of Calaveras Reservoir) (rl-ss)	20	52	5	M	6.8	146	180	90	-122.03; 37.86	-121.81; 37.45	Slip rate based on composite of 5 mm/yr rate reported by Kelson, et. al (1996) and 6 mm/yr creep rate from small geodetic net reported by Prescott and Lisowski (1983).

Table 8.4-1. (continued).

FAULT NAME AND GEOMETRY (ss) strike slip, (r)reverse, (n) normal (rl) rt. lateral, (ll) left lateral, (o) oblique	Distance from PPP (km)**	Length (km)	Slip Rate (mm/yr)	Rank (1)	Mmax (2)	R.I. (3)	Rake	Dip	Endpt. N	Endpt. S	Comment
BAY AREA											
Concord-Green Valley (rl-ss)	60	66	6.00	M	6.9	176	180	90	-122.20; 38.45	-121.98, 37.89	Moderately constrained slip rate for Concord fault based on Snyder et al. (1995). Slip rate of 6 mm/yr should be considered a minimum. No slip rates reported for Green Valley fault.
Greenville (rl-ss)	40	73	2.00	P	6.9	521	180	90	-121.94; 37.98	-121.50; 37.42	Wright, et al (1982) reported a slip rate of about 1 mm/hr, based on an offset stream channel. A 10 km rl offset of a serpentinite body suggests a long term slip rate of 2-3 mm/yr.
Hayward (SE extension) (rl-r-o)	8	26	3.00	U	6.4	220	180	90	-121.90; 37.47	121.72; 37.28	Unconstrained slip rate based on slip budget between adjacent Calaveras flt. and assumed major slip junction of Calaveras and Hayward flt. (WGNCEP 1996). Possible significant reverse component not considered.
Monte Vista-Shannon (r 45, E)	20	41	0.40	P-M	6.8	2410	90	45	-122.19; 37.38	-121.79; 37.21	Poorly constrained slip rate based on vertical separation of late Pleistocene terrace and assumptions of age of terrace (23-120 ka) and flt. Dip reported by Hitchcock et al. (1994). Actual dip and fault width is variable. 15 km width approximates average.
Ortigalita (rl-ss)	60	66	1.00	P	6.9	1153	180	90	-121.28; 37.28	-120.91; 36.76	Poorly constrained slip rate based on vertical slip rate reported by Clark, et al (1984) (0.01-0.04 mm/yr), assumptions regarding H:V ratio, and geomorphic expression of flt. Consistent with about 1 mm/yr.
Point Reyes (r, 50 NE)	105	47	.030	P	6.8	3503	90	50	-123.24; 38.18	-122.83; 37.94	Poorly constrained long term (post-Miocene) slip rate based on vertical offset of crystalline basement (McCulloch 1987).

Table 8.4-1. (continued).

FAULT NAME AND GEOMETRY (ss) strike slip, (r)reverse, (n) normal (rl) rt. lateral, (ll) left lateral, (o) oblique	Distance from PPP (km)**	Length (km)	Slip Rate (mm/yr)	Rank (1)	Mmax (2)	R.I. (3)	Rake	Dip	Endpt. N	Endpt. S	Comment
Sargent (rl-r-o)	30	53	3.00	P	6.8	1200	180	90	-121.94; 37.14	-121.45; 36.87	Slip rate is rl. Creep rate reported by Prescott and Burford (1976). Nolan et al. (1995) reported a minimum Holocene rl slip rate of 0.6 mm/yr in Pajaro River area, found evidence suggesting 0.8m of rl offset and a recurrence interval of about 1.2 ka. However, the penultimate event about 2.9 ka was characterized by about 1.7m of rl offset, suggesting max. earthquake of M 6.9. Recurrence of 1.2 ka used, but further work necessary to resolve maximum magnitude, slip rate, and recurrence.
Zayante-Vergeles (rl-r)	30	56	0.10	P	6.8	8821	180	90	-121.97; 37.09	-121.46; 36.79	Slip rates reported by Clark et al (1984).

(1) W = well-constrained slip rate; M = moderately constrained slip rate; P = poorly constrained slip rate.
(2) Maximum moment magnitude calculated from relationships (rupture area) derived by Wells and Coppersmith (1994)
(3) R.I. = recurrence interval
* Data from Petersen et al. 1996. Probabilistic Seismic Hazard Assessment for the State of Califonia.
** Approximate distance.

Mendocino County, a total distance of 175 miles (280 km). A 53-mile- (86 km-) long Hayward Fault segment extends from San Pablo Bay to an obscure convergence with the Calaveras fault near Mount Misery east of San Jose, California.

Several segments of the Hayward Fault are undergoing fault creep, a very gradual horizontal displacement that occurs both episodically and continuously (Lienkaemper et al. 1991). While fault creep has been documented along many segments of the Hayward Fault between San Pablo and Fremont, it has not been observed along all segments throughout the fault's length. The displacement is almost purely right-lateral although small segments have a vertical component of displacement.

San Andreas Fault

The project site is located approximately 12 miles (20 km) east of the San Andreas Fault. The San Andreas Fault is part of a complex system of faults, isolated segments of the East Pacific Rise, and scraps of tectonic plates lying east of the East Pacific Rise that collectively separate the North American plate from the Pacific plate (Wallace 1990). Relative movement between the Pacific and the North American tectonic plates dominates the regional seismo-tectonic setting. The boundary between the Pacific and North American tectonic plates extends from the Rivera triple junction, south of Baja California, northwards to the Mendocino triple junction. Atwater (1970) and, more recently, Irwin (1990) describe the evolution of the Pacific-North American plate boundary. For much of the length of the plate boundary, and certainly for the site region, the San Andreas Fault functions as a transform fault (tectonic plate boundary) with strike-slip displacement (Wilson 1965).

Local Seismicity

Earthquakes in the Santa Clara Valley and San Francisco Bay area during the past 15 years are concentrated near the juncture of the San Andreas Fault and Calaveras faults, and in the East Bay area. Seismicity along the San Andreas Fault on the San Francisco Peninsula is relatively low compared to the Calaveras-Hayward Fault Zone. On the Hayward Fault, small earthquakes are common throughout most of the fault length through San Pablo southeast to Fremont. South of Fremont, the Hayward Fault is seismically quiet. The seismicity, however, continues along a zone trending more southeasterly, denoting an active connection with the Calaveras fault near the Calaveras Reservoir. On the Calaveras fault north of this juncture there is no obvious correlation between seismicity and the mapped trace of the Calaveras fault. This high level of seismic activity present along the Calaveras fault south of Calaveras Reservoir transfers to the Hayward Fault near Fremont (USGS 1987). Tentative evidence of fault creep has been identified along local segments of the Calaveras fault zone (CDMG 1973).

Although the San Andreas, Hayward, and Calaveras fault zones do not actually pass through the project area, a large magnitude earthquake centered along segments of these fault zones will have a significant impact on local residents and structures.

Earthquake History

A number of moderate to great earthquakes (greater than a M6) have affected the Bay Area; 12 such events have occurred in the last 166 years, averaging one every fourteen years. The major seismic event affecting this area was the 1906 San Francisco earthquake (M 7.9). The epicenter of the 1906 earthquake was approximately 12 miles (20 km) northwest of the project area, and was strongly felt in the Santa Clara Valley. Earthquakes of magnitudes greater that 6 have occurred within 19 miles (30 km) of the Hayward Fault in 1836, 1858, 1864, 1865, 1868, 1898, 1906, 1911, 1984, and 1989. Only the 1836 and 1868 events caused surface rupture of the Hayward Fault. Historically, more earthquakes greater than magnitude 5 have occurred on the Calaveras-Hayward-Rogers Creek fault zone than on the adjacent segment of the San Andreas Fault.

The most recent seismic events in the vicinity of the site include the 1979 Coyote Lake earthquake, the 1984 Morgan Hill earthquake, and the 1989 Loma Prieta earthquake. Evidence of liquefaction has been reported during these events along Coyote Creek, which is located approximately 2 miles (3 km) east of the project site. No information was found reporting the behavior of nearby structures during these seismic events. Earthquakes of magnitude greater than 5.0 that have occurred within 62 miles (100 km) of the site are identified in Table 8.4-2.

8.4.1.5 Geologic Hazards

The most important geologic hazard that could affect the project area is the risk to life and property from a large earthquake event generated by the San Andreas, Hayward, and Calaveras fault zones, which are capable of producing magnitude 7.9, 7.1, and 6.8 events, respectively (See Table 8.4-2).

Earthquake hazards include a number of phenomenon, such as seismic ground shaking, surface rupture, liquefaction, and subsidence and settlement. The susceptibility of a site to a particular hazard is a function of a number of factors including the local geologic conditions, the magnitude and source mechanism of the earthquake, and distance to seismic sources.

The following subsections discuss the potential geologic hazards that might occur in the project area and are based on a literature search.

Seismic Ground Shaking

Seismic waves passing through earth material during an earthquake cause the ground to shake. Severe ground shaking is the most widespread and destructive aspect of earthquakes. The intensity of ground shaking depends on the distance of the earthquake epicenter to the site, the magnitude of the earthquake, site soil conditions, and the characteristic of the source.

Seismic ground shaking is the most likely seismic hazard to affect the site. According to the California Building Code (CBC), 1998 edition, the site is located in Seismic Zone 4. This location implies a minimum horizontal acceleration of 0.4g for use in earthquake resistant design. Mualchin and Jones (1992) produced a map of maximum credible earthquake accelerations for California; their figure for the site indicates a horizontal acceleration of 0.4g associated with a seismic event along the San Andreas and Hayward fault zones.

Ground motions can be estimated by probabilistic method at specified hazard levels. The California Geological Survey prepared seismic shaking maps using consensus information for active and potentially active faults, historical seismicity throughout California, and geologic materials (Petersen et al. 1999). The results of these studies suggest that there is a 10 percent probability that the peak horizontal acceleration experienced at the project site will exceed 0.7g in 50 years, which is equivalent to 1 chance in 475.

Recent observations of geodetic strain and fault creep indicate that the current rate of strain accumulation along the Hayward Fault is approximately 9 mm/yr. Whether this rate is representative of the entire fault zone for the entire 167-year recurrence interval is unknown. However, Coppersmith (1982) estimated a probability of 14 to 26 percent for a M7 event to occur within the next 50 years along the Hayward Fault assuming strain accumulations (slip) rates of 3 mm/yr and 6 mm/yr, respectively.

Table 8.4-2. Earthquakes within 100 km of the project area**.**

Distance[3] (Km)	Source[1]	Date						Location		Local Magnitude	Maximum[2] Intensity
		Year	Month	Day	Hour	Minute	Second	Latitude	Longitude		
6	CDMG	1899	07	06	20	10	--	37.200	121.500	5.8	
13	CDMG	1866	03	26	20	12	0.04	37.100	121.600	5.4	
14	DNA	1979	08	06	17	5	22.44	37.109	121.511	5.9	
15	BRK	1984	04	24	21	15	19.0	37.320	121.700	6.2	
16	T-A	1911	07	01	22	0	0	37.250	121.750	6.6	
17	DNA	1864	02	26	13	47	0.04	36.900	121.500	5.9	
20	DNA	1964	11	16	02	46	41.74	37.060	121.690	5.0	
22	CDMG	1891	01	02	20	--	--	37.300	121.800	5.5	
22	CDMG	1903	08	03	06	49	--	37.300	121.800	5.5	
23	CDMG	1949	03	09	12	28	39.0	37.000	121.500	5.2	VII
23	BRK	1993	01	16	06	29	34.9	37.025	121.459	5.3	
24	CDMG	1865	05	24	11	21	--	37.100	121.800	5.5	
24	CDMG	1955	09	05	02	01	18.0	37.400	121.800	5.5	VII
25	CDMG	1881	04	10	10	0	0.04	37.300	121.300	5.9	
25	CDMG	1897	06	20	20	14	0.04	37.000	121.500	6.2	
25	CDMG	1988	06	13	01	45	36.5	37.393	121.740	5.4	
26	USN	1959	03	02	23	27	17.0	37.000	121.600	5.3	VI
28	PDE	1989	10	25	01	27	26.6	37.078	121.832	5.0	
28	PDE	1989	10	18	0	25	04.9	37.043	121.807	5.0	
28	PDE-Q	2002	05	14	05	00	29	36.967	121.600	5.0	
29	CDMG	1988	06	27	18	43	22.3	37.131	121.878	5.7	
30	CDMG	1865	10	08	20	46	--	37.300	121.900	6.3	
30	CDMG	1967	12	18	17	24	31.9	37.010	121.788	5.3	
31	CDMG	1986	03	31	11	55	39.1	37.525	121.617	5.7	
33	USN	1954	04	25	20	33	28.0	36.900	121.700	5.3	VIII
33	CDMG	1990	04	18	15	46	3.5	36.951	121.702	5.2	
34	CDMG	1974	11	28	23	01	21.8	36.902	121.607	5.2	

Table 8.4-2. (continued.)

Distance[3] (Km)	Source[1]	Date						Location		Local Magnitude	Maximum[2] Intensity
		Year	Month	Day	Hour	Minute	Second				
34	SIG	1989	10	18	0	04	0	37.100	121.800	7.1	IX
34	PDE	1990	04	18	13	41	38.8	36.918	21.670	5.0	
34	CDMG	1990	04	18	13	53	50.5	36.872	121.670	5.4	
35	CDMG	1883	03	30	15	45	--	36.900	121.600	5.6	
35	CDMG	1890	04	24	11	36	--	36.900	121.600	6.0	
35	CDMG	1974	11	28	23	01	24.70	36.910	121.480	5.2	
35	CDMG	1989	08	08	08	13	27.4	37.145	121.927	5.4	
37	CDMG	1899	04	30	22	41	--	36.900	121.700	5.6	
38	CDMG	1914	11	09	02	31	--	37.170	122.000	5.5	
39	CDMG	1866	07	15	06	30	--	37.500	121.300	5.8	
39	CDMG	1963	09	14	19	46	17	36.870	121.630	5.4	
40	CDMG	1910	03	11	06	52	--	36.900	121.800	5.5	
42	CDMG	1858	11	26	08	35	0.04	37.500	121.900	6.1	
45	CDMG	1910	12	31	12	11	--	36.830	121.420	5.0	
46	CDMG	1892	11	13	12	45	0.04	36.800	121.500	5.6	
46	CDMG	1903	06	11	13	12	--	37.600	121.800	5.5	
47	CDMG	1870	02	17	20	12	--	37.200	122.100	5.8	
47	DNA	1939	06	24	13	01	54.04	36.800	121.450	5.5	
47	CDMG	1989	10	18	0	7	43.4	36.989	121.737	5.1	
48	CDMG	1882	03	06	21	45	--	36.900	121.200	5.7	
48	CDMG	1885	04	02	15	25	--	36.800	121.400	5.4	
50	BRK	1960	01	20	03	25	53.0	36.780	121.430	5.0	
52	PDE	1986	01	26	19	20	51.20	36.810	121.275	5.5	
52	PDE	1988	02	20	08	39	57.50	36.803	121.302	5.3	
52	CDMG	1998	08	12	14	10	25.1	36.755	121.464	5.4	
57	CDMG	1884	03	26	00	40	--	37.100	122.200	5.9	
59	ISC	1980	01	27	02	33	34.9	37.776	121.753	5.0	

Table 8.4-2. (continued.)

Distance[3] (Km)	Source[1]	Date						Location		Local Magnitude	Maximum[2] Intensity
		Year	Month	Day	Hour	Minute	Second				
60	DNA	1926	10	24	22	51	49.54	37.020	122.200	5.5	
62	CDMG	1885	03	31	07	56	--	36.700	121.300	5.5	
62	CDMG	1961	04	09	07	25	41	36.700	121.300	5.5	
63	CDMG	1864	05	21	02	01	0.04	37.500	122.000	5.3	
64	CDMG	1961	04	09	07	23	16	36.680	121.300	5.6	
65	CDMG	1864	03	05	16	49	--	37.700	122.000	5.7	
67	CDMG	1916	08	06	19	38	--	36.670	121.250	5.5	
68	CDMG	1927	02	15	23	54	03.50	36.950	122.260	5.0	
70	DNA	1868	10	21	15	53	0.04	37.700	122.100	6.8	
71	CDMG	1856	02	15	13	25	0.04	37.600	122.400	5.5	
74	CDMG	1861	07	04	00	11	--	37.800	122.000	5.6	
75	PDE	1977	10	18	10	8	18	36.594	121.246	5.5	
75	SIG	1980	01	24	19	0	0	37.800	121.800	5.9	VII
75	PDE	1995	04	23	08	41	36.62	36.603	121.201	5.0	
78	CDMG	1972	02	24	15	56	51	36.578	121.209	5.0	
78	PDE	1986	01	14	03	09	36.30	36.572	121.205	5.0	
79	CDMG	1951	07	29	10	53	45	36.580	121.180	5.0	
82	DNA	1898	03	31	07	43	0.04	38.200	122.400	6.5	
84	DNA	1838	06	--	--	--	--	37.600	122.400	7.0	
85	DNA	1836	06	10	15	30	0.04	37.800	122.200	6.8	
85	CDMG	1889	07	31	12	47	--	37.800	122.200	5.2	
88	CDMG	1856	01	02	18	15	--	37.500	122.500	5.3	
90	CDMG	1938	09	27	12	23	--	36.450	121.250	5.0	
91	CDMG	1889	05	19	11	10	--	38.000	121.900	6.0	
93	USN	1955	10	24	04	10	44.0	38.000	122.000	5.4	VII
94	USN	1957	03	22	19	44	21.0	37.700	122.500	5.3	VII

Table 8.4-2. (continued.)

Distance[3] (Km)	Source[1]	Date						Location		Local Magnitude	Maximum[2] Intensity
		Year	Month	Day	Hour	Minute	Second				
96	G-R	1926	10	22	12	35	11.0	36.700	122.000	6.1	VIII
97	CDMG	1899	06	02	07	19	--	37.700	122.500	5.4	
97	SIG	1906	04	18	13	12	0	38.000	123.000	8.3	XI
97	CDMG	1926	07	25	17	57	49	36.600	120.800	5.0	
98	PDE	1984	01	23	05	40	19.70	36.373	121.907	5.4	
99	CDMG	1870	04	02	19	48	--	37.900	122.300	5.3	
99	PDE	1984	01	23	06	59	50.40	36.373	121.907	5.0	

(1) BDS M. Bath and S. Duda (1979).
BRK Berkeley, Haviland, California, USA.
CCN Central California Network (See U.S. Geological Survey 1969-77).
CDMG California Division of Mines and Geology (Real and others 1978).
DNA Decade of North American Geology (DNA project).
G-R Gutenberg and Richter, 'Seismicity of the Earth'.
GS U.S. Geological Survey, Denver, CO, USA.
ISC International Seismological Centre, Newbury, UK.
NAO Norse Array Observatory, Norway
PAS Pasadena, California.
PDE Preliminary Determination of Epicentres from NEIS/CDMG.
ROT Rothe, J.P. 'The Seismicity of the Earth', 1953-1965, UNESCO 1969.
SIG Catalog of Significant Earthquakes (Dunbar, Lockridge, Whiteside 1993).
T-A S. D. Townley and M. W. Allen (1939).
USN U.S. Network Catalog (Hays and others 1975).

(2) "Maximum Intensity" is another measurement of perceptible ground movement. However, Local Magnitude was used whenever possible throughout the study.

(3) "Distance in kilometers" is equal to the radial distance from the site.

Earthquake planning scenarios published by the San Francisco Association of Bay Area Governments ([ABAG] 1995) were reviewed for the San Andreas Fault and Hayward Fault. The planning scenarios contained predicted seismic intensity distribution maps (PSIDM) for a M7.9 and M6.9 earthquakes on the San Andreas Fault based on 1906 and 1989 (Loma Prieta) earthquakes, and a M7.3 for the Hayward Fault that is based on a postulated rupture of the entire 53-mile (86 km) length of the fault. The PSIDM depict moderate to heavy shaking (Modified Mercalli Intensity of VIII to IX), with moderate to heavy damage of some buildings. Each scenario takes into account the various ground (geologic) conditions and its impact on seismic wave fronts.

Ground Rupture

Surface ground rupture along faults is generally limited to a linear zone a few meters wide. Ground rupture is not considered a potential seismic hazard at the plant site and gas pipeline because there are no known active faults crossing the project area or in the immediate vicinity (Terratech 1986 and CDMG 1991). In addition, the site is located outside the Special Studies Zones defined by the Alquist-Priolo Geologic Hazards Act of 1972.

Ground Failure/Liquefaction

Liquefaction is a process by which water-saturated materials (including soil, sediment, and certain types of volcanic deposits) lose strength and may fail during strong ground shaking. Liquefaction is defined as "the transformation of a granular material from a solid state into a liquefied state as a consequence of increased pore-water pressure" (Youd 1992). This behavior is most commonly induced by strong ground shaking associated with earthquakes. In some cases, a complete loss of strength occurs and catastrophic ground failure may result. However, liquefaction may happen where only minor shaking occurs, and ground surface deformations are much less serious. The potential for liquefaction is highest in clay-free granular sediments (sand and silt fraction) that are water saturated, poorly consolidated, and well sorted.

In the event of a major earthquake, sediments underlying the project area, specifically at the plant site and gas pipeline, have a high liquefaction potential (ABAG 2001). This "high potential" is attributed to the seismic activity of the San Andreas and Hayward fault zones, the shallow depth to groundwater (about 12.5 feet), and the unconsolidated deposits beneath the site. Also, as defined by the Seismic Hazard Mapping Act of 1990, the project area is identified as Seismic Hazard Zone with liquefaction as the designated hazard.

There are four types of ground failure or collapse of soil structures that commonly result from liquefaction: lateral spread, flow failure, ground oscillation, and loss of bearing strength. Based on the site geology and topography, there is a moderate to high potential for the effects of lateral spread, ground oscillation and loss of bearing strength to be experienced in the event of a major earthquake. Each type is briefly defined below:

Lateral Spread

This term defines the lateral displacement of surficial blocks of sediment as the result of liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluidized mass, gravity plus inertial forces that result from the earthquake may cause the mass to move downslope towards a cut slope or free face (such as a river channel or a canal). Lateral spreads most commonly occur on gentle slopes that range between 0.3° and 3°, and commonly displace the surface by several meters to tens of meters. Such movement typically damages pipelines, utilities, bridges, and other structures having shallow foundations. During the 1906 San Francisco earthquake, lateral spreads causing displacement of only a few feet damaged many water supply pipelines. Thus, liquefaction compromised the ability to fight the fires that caused about 85 percent of the damage to San Francisco.

Ground Oscillation

When liquefaction occurs at depth and the slope is too gentle to permit lateral displacement, the soil blocks that are not liquefied may decouple from one another and oscillate on the liquefied zone. The resulting ground oscillation may be accompanied by opening and closing of fissures and sand boils, which may damage structures and underground utilities.

Loss of Bearing Strength

When a soil loses strength and liquefies, loss of bearing strength may occur beneath a structure, possibly causing the structure to settle and tip. If the structure is buoyant, it may float upward.

Subsidence and Settlement

Land surface subsidence can be induced by both natural and human phenomena. Natural phenomena include: subsidence resulting from tectonic deformations and seismically induced settlements; soil subsidence due to consolidation, hydrocompaction, or rapid sedimentation; subsidence due to oxidation or dewatering of organic-rich soils, and subsidence related to subsurface cavities. Subsidence related to human activity includes subsurface fluid or sediment withdrawal. Underground mining may also cause subsidence, but that is not a factor at this locality.

Between 1934 and 1967, up to 8 feet of subsidence occurred in the central portion of the Santa Clara Valley and up to 6 feet of subsidence was documented in the vicinity of the project area (Helley et al. 1979). The primary cause of subsidence was the compaction of fine-grained, clayey sediments in the central part of the valley where the groundwater table was lowered drastically by pumping. Subsidence was virtually halted in 1971 because the groundwater table was raised by an extensive groundwater recharge project (Helley et al. 1979).

Due to the loose, compressible nature of the floodplain and levee deposits present at the site, there is a potential for soil settlement to occur. Settlement would primarily be a consequence of an increase in overlying burden from construction of structures associated with the project facilities. In the event of a major earthquake, subsidence and settlement has the potential to occur as a result of ground failure from liquefaction.

Expansive/Compressive Soils

Expansive soils have the ability to shrink and swell with wetting and drying. The shrink-swell potential of expansive soils can result in differential movement beneath foundations. Mapped deposits in the vicinity of the project area (Qhb) (see Figure 8.4-1) are considered to be expansive due to their relatively high clay content (Helley et al. 1979). In addition, findings from a geotechnical investigation conducted at the site (Terratech 1986) indicates that a clayey soil, which is highly plastic and exhibits a high expansion potential, is present from about 2 feet to 4.5 feet below grade.

8.4.1.6 Geologic Resources

A gravel pit was shown on the Milpitas 7.5-Minute Quadrangle immediately east of the proposed route of the natural gas pipeline. However, this gravel pit was not identified in CDMG’s Special Publication 103 titled, *Mines and Mineral Producers Active in California* (revised 1999). The natural gas pipeline will be located primarily in the right-of-way along Lafayette Avenue and therefore no impacts are anticipated with respect operations at this potential gravel pit. Based on literature review, there are no known mineral resources associated with the project area (CDMG 1999).

Recreational geologic resources typically include rock or mineral collecting, volcanoes, surface hydrothermal features, or surface expression of geologic features unique enough to generate recreational interests of the general public (e.g., natural bridges, caves, features associated with glaciation, and geomorphic features such as waterfalls, cliffs, canyons, and badlands). There are no known recreational geologic resources associated with the project area based on the review of the geological literature, CMDG 1999, and the topographic maps.

8.4.2 Environmental Consequences

The potential environmental effects from construction and operation of the PPP on geologic resources and risks to life and property from geologic hazards are presented in the following subsections.

8.4.2.1 Significance Criteria

The project would cause a significant adverse impact to geological resources if it would:

- Significantly reduce access to geological or mineral resources of economic importance.
- Present a significant risk of injury by exposing people or structures unnecessarily to the consequences of major geologic hazards such as large seismic events.
- Cause large-scale erosion or land subsidence.

The potential for land subsidence, either seismically induced or by proposed building load factors and liquefaction hazards is further evaluated in a geotechnical investigation (Appendix 10-G).

8.4.2.2 Construction Phase Impacts

Power Plant Site

Preparation of the ground surface at the power plant site will involve grading, leveling, and filling. The plant site is situated on floodplain deposits (Qhb). These sediments may require some additional drainage measures because of the relatively high clay and silt content; otherwise, they present minimal problems for preparation of a level surface on which to construct the power plant. The plant site will occupy 2.86 acres of land. The site will be graded to achieve a minimum one percent slope to promote surface drainage, and areas adjacent to equipment will be surfaced with asphalt or concrete. Slopes will be provided with temporary drainage and erosion control measures during construction until permanent measures are installed. If there is excess material that cannot be used, it will be disposed of at a suitable location offsite. Site grading will not result in large-scale erosion or adverse impacts to the geological environment.

There is a potential for strong seismic ground shaking to affect the plant site in the event of a large magnitude earthquake occurring on fault segments associated with the San Andreas, Hayward, or Calaveras fault zones. Seismic hazards and potential adverse foundation conditions will be minimized by conformance with the recommended seismic design criteria of the CBC (CBC [1998]) Seismic Zone 4 requirements. The seismic requirements are further defined in Appendix 10-B titled, "Structural Engineering Design Criteria" and are found in Section 10B.3.6 titled, "Seismic Design Criteria". The facility arrangement is such that no major structures or equipment are within the projected trace of any active or potentially active faults.

Natural Gas Compressor Station

The natural gas compressor station is located near the power plant site, and as at the power plant site, rests on floodplain deposits (Qhb). Drainage and grading conditions at the gas compressor station will be the same as, or similar to, those for the power plant site. Construction measures will be the same. The compressor station construction area is approximately 10,000 square feet in area (0.23 acre).

Natural Gas Pipeline and Metering Station

Land disturbance during construction of the 2.0-mile buried natural gas pipeline will be 2-3 feet wide, since the pipeline will be constructed within the roadway pavement. Pipeline excavation to a minimum depth of about 4 feet (1.3 m) in the floodplain (Qhb) and levee (Qhl) deposits may be performed with a backhoe or trenching machine, and the soil temporarily laid in a berm next to the trench. After the pipe is connected, it will be laid in the trench on a soil cushion and the trench backfilled with soil. The bored-and-jacked casing method will be used to cross under the Union Pacific Railroad tracks and under Highway 101. Construction of the natural gas pipeline is not expected to negatively impact any geological or mineral resources since there are no known mineral resources along the pipeline route. The metering station will involve disturbance of an area 30 x 60 feet.

Waste Water Discharge Pipeline

Construction of the waste water discharge pipeline between the PPP and Central Expressway will use the same street trenching methods as for the natural gas pipeline. The 900-foot-long pipeline will be excavated with a backhoe, in floodplain (Qhb) deposits, with soil temporarily laid in a berm next to the trench. Erosion control methods and potential impacts will be the same as for the natural gas pipeline.

Construction Laydown and Worker Parking Areas

These areas occur on developed land on previously disturbed ground. No significant adverse impacts to geological resources are expected.

8.4.2.3 Operation Phase Impacts

Power Plant Site and Compressor Station

The plant structures and equipment and natural gas compressor station will be designed in accordance with CBC, Seismic Zone 4 requirements, which are further defined in Appendix 10B, Section 10B.3.6.1. Compliance with the CBC (1998), Seismic Zone 4 requirements will minimize the exposure of people to the risks associated with large seismic events. In addition, the major structures will be designed to withstand the strong ground motion of a design earthquake. A design earthquake is the postulated earthquake that is used for evaluating the earthquake resistance of a particular structure. Because the seismic hazard in the region of the project area is relatively well defined, the design earthquake will be established by the maximum, or characteristic, magnitude earthquake that can potentially occur on those faults identified on Table 8.4-1.

No major structures or equipment are within the projected trace of any active faults.

Natural Gas Pipeline and Metering Station

The natural gas pipeline will be constructed in unconsolidated deposits of silt, clay, and organic rich material (Qhb and Qhl). The pipeline will be designed to withstand the strong ground motion and ground failure (liquefaction) of a design earthquake.

Waste Water Discharge Pipeline

The waste water discharge pipeline will be constructed in unconsolidated Quaternary deposits of silt, clay, and organic rich material (Qhb). The pipeline will be designed to withstand the strong ground motion and ground failure (liquefaction) of a design earthquake.

8.4.3 Cumulative Impacts

The project facilities will be constructed to the requirements of the CBC Seismic Zone 4. Site-specific geotechnical investigations will be performed prior to final design and construction. Since construction and operation of the project will not cause significant impacts to geological resources, it will not cause cumulative impacts to geological resources.

8.4.4 Proposed Mitigation Measures

Mitigation measures for the project are as follows:

- Perform geotechnical field surveys to locate geologic hazards at the plant site and natural gas and waste water discharge pipeline routes to evaluate their impact on the construction activities and the environment.
- Conduct a geophysical investigation, as required by the Seismic Hazard Mapping Act (1990), to quantify the liquefaction potential at the site. The investigation will be conducted prior to facility construction and in accordance with recommended methods outlined in CDMG's Special Publication 117 titled, "Guidelines for Evaluating and Mitigating Seismic Hazards in California" (1997). In addition, the investigation will address potential hazards associated with land settlement and subsidence and expansive/compressive soils, which underlie the project area.
- Structures will be designed to meet seismic requirements of the 1998 CBCs. Moreover, the design of plant structures and equipment will be in accordance with CBC, Seismic Zone 4 requirements to withstand the strong ground motion of a design earthquake. In addition, special design considerations will be made to constructed facilities if warranted by the findings from the geotechnical investigation.
- An engineering geologist(s), certified by the State of California, will be assigned to the project to carry out the duties required by the CBC to monitor geologic conditions during construction and approve actual mitigation measures used to protect the facility from geologic hazards.
- Modifications of existing topography will not destroy any unique geologic or topographic features.

8.4.5 Applicable Laws, Ordinances, Regulations, and Standards

Design, construction and operation of the PPP will be conducted in accordance with applicable laws, ordinances, regulations, and standards (LORS) pertinent to geologic resources and hazards during and following construction. The LORS are summarized in Table 8.4-3.

Table 8.4-3. LORS Applicable to geologic resources and hazards.

LORS	Applicability	Mitigation Effective?	AFC Reference
CBC (California Building Code)	Design and construction of manmade structures with respect to seismic safety features; design and construction of open excavations.	Yes	Section 8.4.2.1. 8.4.5.2

8.4.5.1 Federal

The Uniform Building Code (UBC [1997]) specifies the acceptable design criteria for construction of facilities with respect to seismic design and load bearing capacity. However, the CBC incorporates by reference the UBC and contains additional requirements, and is the applicable code to be followed for the project.

8.4.5.2 State

The CBC (1998) specifies the acceptable design criteria for construction of facilities with respect to seismic design and load-bearing capacity.

8.4.6 Involved Agencies and Agency Contacts

There is one agency that is involved with geologic resources and hazards at the project site. The agency contact is listed in Table 8.4-4.

Table 8.4-4. Involved agencies and agency contacts.

Issue	Contact/Agency	Title	Telephone
Building Permit; Grading/Drainage/Erosion Control Permit	City of Santa Clara Department of Public Works	Planning and Permitting	(408) 615-3000

8.4.7 Permits Required and Schedule

Permits required for matters dealing with geologic resources and hazards for the project and the schedule to obtain each of these permits are provided in Table 8.4-5. Information required to obtain each permit is also included.

Table 8.4-5. Permits required and permit schedule.

Permit/Required Information	Schedule
Building Permit including Seismic Design Criteria: • 30 day review and approval process • Requires structural, civil, electrical and mechanical plans • Geotechnical/Geologic report • Identify geologic hazards and potentially conduct a seismic risk analysis • Architectural plans	Submit application 30 days prior to start of construction.
Grading/Drainage/Erosion Control Permit: • Engineered Grading Plan • Topographic Plan • Drainage controls • Surface Hydrology Report • Geotechnical/Geological Hazard Evaluation • Identify material source or disposal location and haul route • Erosion and Dust Control Plan • Traffic Control Plan	Submit application 30 days prior to start of construction activities.

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